THE TREATMENT OF INJURIES OF THE SPINE AND CORD BY SAYRE'S PLASTER-OF-PARIS JACKET.[1]

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THE suggestion of immediate fixation in spinal injuries by the use of Sayre's plaster-of-Paris jacket is neither new nor original with the writer; but the tangible results which he has observed from personal experience, and the information which he has obtained from a careful study of the literature of the subject, have induced him to bring before this society some points for discussion in the management of these unfortunate cases.

It is a well-known fact that patients afflicted with spinal injuries are considered undesirable from a clinical point of view. They are transferred from one hospital to another until one of the eleemosynary institutions upon the island becomes their temporary abode. Nurses dislike to see these helpless creatures admitted to their care, and surgeons are disinclined to allot them space in their hospital wards. The great labor of caring for these unfortunate patients, and their lack of surgical interest, makes them unintentionally a most uninteresting and unwelcome class of cases.

The utter helplessness, the intense suffering, the absolute hopelessness, the wretched discomfort, the living death make them objects likewise of pity to all under whose care they come. On the other hand, the recent advances in the science of neurology, the precision of topographical anatomy, the modern re-

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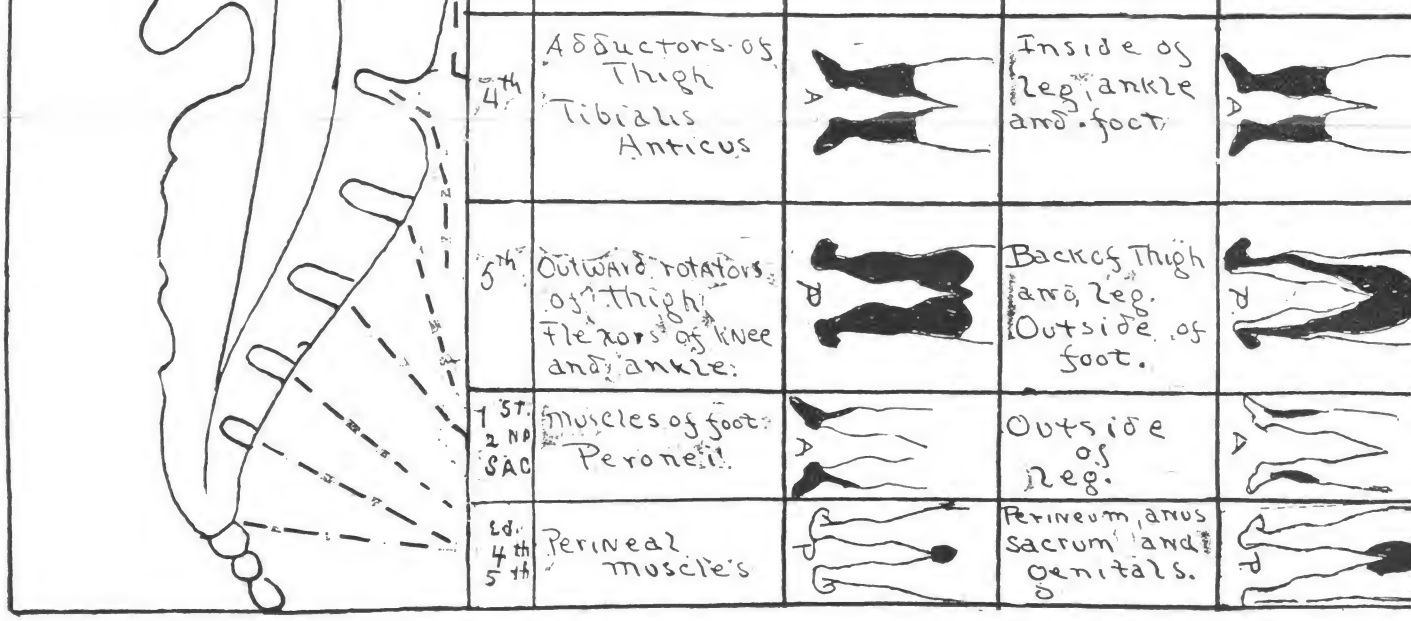

The muscles governed by the injured segment are paralyzed and become flabby and atrophied. Those governed by segments below the point of to motion and sensation, but do not atrophy. This is due to the fact that their centres of nutrition in the cord are uninjured. If no treatment is institu and descending degeneration of the cord takes place, causing atrophy of the muscles governed by the various segments.

PRIAPISM is frequently seen in fractures of the upper part of the spinal column, and is due to the cutting off of inhibitory impulses from the hig

The BLADDER and RECTAL centres are in the lower lumbar segments, and traumatism in this region causes incontinence of urine and fæces. retention.

TYMPANITES is seen in injuries to the upper part of the cord; it is due to paralysis of peristalsis.

BROWN-SÉQUARD'S paralysis (loss of motion on one side and of sensation on the other) is seen in unilateral lesions of the cord, such as migh It is due to the immediate decussation of the sensory fibres on entering the cord. It is not seen at first, as the general bruising causes bilateral paralysis.

REFLEXES. PUPIL: Dilatation produced by pinching side of neck. SCAPULAR: Scratching skin over scapula causes muscles to cor Tapping tendon at wrist causes flexion of arm. TRICEPS: Tapping elbow tendon causes extension of arm. POSTERIOR WRIST: Tapping tend hand. ANTERIOR WRIST: Tapping tendons causes flexion of wrist. PALMAR: Scratching palm causes flexion of fingers. EPIGASTRIC: S retraction of epigastrium. ABDOMINAL: Stroking abdomen causes retraction. CREMASTERIC: Stroking inner thigh causes retraction of sc Striking patellar tendon causes extension of leg. GLUTEAL: Stroking buttock causes dimpling in gluteal fold. PLANTAR: Stroking sole of foot ca retraction of leg. ANKLE CLONUS: Forcible extension causes rhythmical flexion.

searches in physiology, the introduction of anæsthetics and antiseptics, the wonderful inventions in mechanical art present a most urgent appeal to the thoughtful surgeon to devote more attentive study to the management of these cases. The "do-nothing" plan terminates in death, the application of well-recognized surgical principles to this peculiar class of hitherto neglected cases has demonstrated the possibility of salvation in at least a limited number. The writer, in his paper this evening, will restrict himself to a consideration of traumatism of the spine and cord, and he will also limit himself to the subject of the treatment by the plaster-of-Paris jacket.

Traumatisms of the spine and cord include fractures and dislocations, hæmorrhage, gunshot wounds, laceration, severance, suppuration, secondary changes, such as myelitis, meningitis, and pressure by inflammatory exudates.

If *direct violence* is applied to the spine a fracture usually results. The *seat* of the fracture has much to do with the prognosis, since a fracture of the processes is of less gravity than a fracture of the body of the vertebræ. Owing to the great prominence of the processes of the cervical vertebræ, it has been shown that more than one-half of the cases of fracture of this segment of the spine belong to the processes rather than to the bodies, while more than two-thirds of the fractures in the dorso-lumbar region belong to the bodies of the vertebræ instead of the processes. On the other hand, it must be remembered that the nearer the fracture is to the medulla the greater the dangers both immediate and remote. In all fractures of the spine, irrespective of the situation, the question of injury to the cord itself is the key to the prognosis.

In a general way it may be stated that a fracture above the third cervical vertebra terminates instantly in death from pressure of the odontoid process into the cord or paralysis of the phrenic nerve. A fracture occurring in the dorsal region usually terminates fatally in about three weeks from hypostatic pneumonia, while a fracture in the lumbar region usually leads to death in about three months on account of renal trouble.

The *signs and symptoms* of fracture of the spine vary ac-

cording to the *amount of compression* to which the cord is subjected. They also vary according to the *seat* of the fracture. If the cord is not compressed, the signs of fracture of the spine are chiefly local. This condition may occur in fractures of the processes of the vertebræ. The localized point of tenderness, the ecchymosis, the swelling, the irregularity in the line of the spinous processes, the pain, the inability to move, the crepitus, the loss of the natural contour of the back, and the depression over the injured spot, all serve as evidences of the existence of a fracture.

If, on the other hand, the cord is compressed by the fragment, the symptoms are characteristic, among which, in addition to those already mentioned, are loss of motion in those muscles which are supplied by nerves passing through the seat of lesion and anæsthesia in the part correspondingly supplied, and a small area of hyperæsthesia upon the back just above the lesion. The writer has prepared, with considerably difficulty, a chart which will enable the surgeon at a glance to locate even to the numerical vertebra the precise seat of fracture in the spine, so that the diagnosis can be established upon a scientific, anatomical, and neurological basis.

If *indirect violence* is applied to the spine a dislocation is likely to occur, especially in children. The cervical region is more frequently the seat of a dislocation than the dorso-lumbar region. Dislocations are caused by suddenly bending the spinal column backward, or by striking the head in diving, or by forcibly bending the spinal column forward, as in passing under a low arch. If there is any compression of the cord, the signs and symptoms are similar to those observed in fracture. *Hæmorrhage* may occur as a result of traumatism, and the extravasated blood may be found between the dura mater and the bony walls of the spinal canal or beneath the dura mater, or even in the substance of the cord itself.

The *symptoms* of spinal meningeal hæmorrhage are sudden, acute, and very severe pain in the back and limbs, accompanied by numbness and prickly sensations in the feet. These symptoms are very quickly followed by impairment of motion in the

limbs and subsequently by paralysis and anæsthesia. This group of symptoms appears in the general order mentioned a short time after the injury. There is an appreciable period between the traumatism and the appearance of the symptoms.

The *symptoms* of hæmorrhage in the substance of the cord develop more rapidly than those of hæmorrhage in the meninges, and the symptoms, too, are more pronounced. In a meningeal hæmorrhage the pain is very severe, paralysis is not so prominent, and muscular spasm is more pronounced than when the hæmorrhage is situated in the cord itself.

These cases of fracture and dislocation and of spinal hæmorrhage are benefited by the use of the jacket. The fixation of the spine relieves the pain and keeps the parts quiet during the repair of the fracture or the partial absorption of the extravasated blood. If the lesion is in the cervical region, the prospects of recovery are not so favorable as is the case when the hæmorrhage is in the lumbar region.

Gunshot wounds of the spine and cord are attended by a high rate of mortality, which is influenced by the situation of the injury. The higher the injury in the cord the higher the rate of mortality. Thus in the war of the Rebellion the death-rate in gunshot injuries of the cervical region was 70 per cent., in the dorsal region 63.5 per cent., in the lumbar region 45.5 per cent. The introduction of antiseptic surgery will lessen this high rate of mortality; but it will only affect the diminution as regards sepsis.

The *symptoms* of gunshot wound of the vertebra and cord are those which are common in any other variety of injury of the spine and cord, with, perhaps, additionally an aggravated condition of shock. The back is motionless, paralysis, anæsthesia, and hyperæsthesia with lightning pains of a growing, girdling nature, are present, as also difficulty in respiration, in circulation, in micturition, and in defecation. There is also present a tendency to the development of trophic gangrene, and, finally, there is an escape of cerebro-spinal fluid in case the meninges are wounded. If the bullet has not penetrated deeply into the bony structure of the vertebral column or wounded the cord, many of the signs

just mentioned may be present as a result of contusion of the cord producing a slight laceration. These symptoms are of temporary duration, and soon subside, leaving behind them no disagreeable after-effects. The presence of so much fluid in the vertebral canal make cases of contusion and concussion less frequent than corresponding injuries of the brain.

In military practice the prognosis in gunshot wounds of the spine and cord is very grave, as high as nine-tenths of the cases have died within a few days following the injury. If the bullet wound is in the cervical region the mortality is very high. Whereas, if the wound is in the lower lumbar or sacral regions, a few recoveries have been reported, asepsis will lessen the high rate of mortality; but it will have no appreciable influence in the death-rate over such factors as shock, hæmorrhage, and injury to internal viscera. If a patient recovers from the immediate effects of the injury, there is sure to follow a train of most distressing symptoms, such as atrophies, contractures, neuralgic pains, ataxia, disturbances of the function of the brain, cord, and bladder, as well as meningeal thickenings and scleroses.

Laceration of the cord, either with or without fracture or dislocation, occurs as a result of traumatism. The laceration may be limited or may be very extensive, and the secondary changes, such as softening and myelitis, make the prognosis most serious.

Spinal meningitis occurs as a result of pressure in fractures and dislocations, and also from gunshot injuries. A spinal meningitis may also have its origin from extension of sepsis, from a bedsore, and from caries, giving rise to psoas or lumbar or cervical abscess. The symptoms of spinal meningitis following injury are paralysis, anæsthesia, hyperæsthesia, girdle pains, spasm of the muscles, nausea, vomiting, convulsions, chills, elevation of temperature, rapid pulse, delirium, cystitis, pyelitis, and nephritis.

Myelitis occurs as a result of the same causes, and many of the symptoms are in certain respects common; although they are as a class much less severe. The function of cord is lost earlier than in spinal meningitis, the pain is not so severe,

the chill is usually absent, the temperature is not so high; but urinary troubles and inflammations tending to gangrene are often present.

In both *spinal meningitis* and *myelitis*, consecutive to traumatism, the symptoms are present, which the application of the jacket will greatly relieve, and in some cases cure. In the list of cases of injury to the spine and cord, spinal meningitis and myelitis have been present, and yet the patients have been practically cured.

In traumatism of the spine, where the cord shows symptoms of pressure myelitis, a differential diagnosis must be made between the compression made by *continued pressure which is not relieved*, and a compression of the cord made by the vertebra in which a recoil has taken place. In the former case the prognosis is exceedingly serious, while in the latter the prospects are not so unfavorable. In the *cervical* region a displacement with recoil is more common than permanent displacement and consequent pressure.

Burrell has demonstrated the important clinical fact that, "where the bodies of the vertebræ were displaced upon themselves, the cord not being torn, a pressure lasting twenty-four to forty-eight hours upon the cord was sufficient to produce irremediable softening."

The *treatment* of all these different varieties of traumatism of the spine and cord by the plaster-of-Paris jacket has met with brilliant results. Before the employment of the jacket these cases were doomed to unalleviated suffering and death. The jacket in gunshot injuries affords a means of fixation after laminectomy, or if laminectomy is not performed, a means of preventing a certain amount of pain, as well as certain inflammatory sequelæ. In laceration of the cord the use of the jacket cannot be too highly extolled, since there are many cases in which the jacket has proved itself of very great benefit in this variety of traumatism. In spinal meningitis and in myelitis the cases of recovery are numerous where the jacket has been employed in Pott's disease. There is no reason why the same brilliant results should not follow the application of the jacket when used in

connection with spinal meningitis or myelitis secondary to traumatism. The same beneficial results should follow in both cases.

There is nothing new in the technique of the application of the jacket in the cases of traumatism of the spine and cord, except that extension and counter-extension must be employed in a different manner from that in which it is used in the treatment of Pott's disease, or even in lateral curvature, since in both of these conditions the patient can be suspended. In traumatisms of the spine the danger of this method in recent cases needs no comment, as sudden death can occur by displacement of the fragments in attempts to place the patient in the vertical position. The tripod may be used later after bony anchylosis has occurred, but its use even then is attended with danger, and its application immediately upon the receipt of a fracture is to be condemned.

There have been several methods employed to accomplish extension and counter-extension in the application of the jacket in cases of spinal injuries.

Davy employed extension by placing the patient upon a piece of canvas, about fifteen feet long and two feet wide. The patient was wrapped in this hammock and suspended while the plaster jacket was applied.

Berkely Hill placed his patient upon a board, which was swung upon two pivots like a mirror. The patient was then placed vertically by raising the board to an upright position.

Sayre has used the tripod in order to effect extension, while other surgeons have employed compound pulleys. The writer has fastened the patient upon two stretchers, and placed them end to end. The stretchers are then pulled apart, and the plaster jacket applied to the chest in the space left by the separation of the stretchers.

Stewart has suggested an improvement upon the stretchers by employing two ordinary kitchen tables, which are separated in the same manner as already described. Extension and counter-extension are maintained by several assistants, who are placed at the feet and the head of the patient. This extension is continued until the plaster has set. Perforated strips of sheet-iron or zinc or tin can be used after the manner of stays in a

corset, and their employment prevents any shortening of the trunk after its hyperextension.

The use of an iron stand to support the back while the plaster is applied is of great service, since it prevents any sinking of the vertebral column at the seat of the special injury. The advantage of this stand is at once apparent, since the danger of compressing the cord is overcome by the use of this mechanical support. The entire back is supported by the parallel bars which pass up each side of the spinous processes.

The requisite time to accomplish a cure by the use of the jacket is subject to variation. It is seldom that any benefit will be derived unless the use of the jacket is continued for many months. The application of the jacket for a few days is of little avail, and its use should be extended over many weeks, during which time, however, the formation of bedsores must be carefully guarded against, since the conditions are especially favorable for their development.

In the application of the jacket it is most important that the best plaster of Paris should be used. Inferior plaster will not set quickly enough, and the usefulness of the splint is destroyed. The surgeon should bear in mind the possibility of sudden death during the application of the plaster, and he should exercise every possible precaution to prevent such an unfortunate accident.

The results which have followed the use of the plaster-of-Paris jacket are most gratifying, when it is taken into consideration that these cases formerly terminated in death.

The writer desires to refer to a case of fracture of the lower cervical vertebra, which occurred in the practice of the late Dr. James R. Wood, in 1877. This patient sustained a fracture of the cervical spine, which was attended with loss of motion and sensation of both upper and lower extremities and also the trunk. Vesical and rectal paralyses were also present. The patient was encased in a plaster-of-Paris jacket some ten days after the injury, and in a few weeks the symptoms were greatly relieved, and eventually the patient fully recovered. He was subsequently present at my clinic and seemed perfectly well, and had resumed

his usual work as a carpenter. The photograph of the patient illustrates the method which was employed. (Figs. 1 and 2.)

There is another case of fracture of the spine with loss of motion and sensation, together with the other symptoms, in which recovery has occurred from the use of the jacket in my own hospital service. This patient has kindly consented to be present this evening in order to show how well he can walk, and, although he was confined to a water-bed for six months, and motion and sensation were both absent and vesical and rectal trouble present, he is practically well and has resumed work.

The writer has been able to collect thirty-three cases of recovery after unmistakable fracture of the spine. Many other cases have been eliminated in which improvement only was noted. This list is sufficiently large to attract the attention of surgeons and to induce them to employ this method of treatment in all forms of traumatisms of the spine and cord.

Burrell has reported 8 cases; Dennis, 1; Dandridge, 2; Gibney, 2; Keetley, 1; Hill, 1; Harrison, 1; König, 1; Sayre, 13; Wood, 1; Woodbury, 1; Gerster, 1. Total, 33.

To this list of satisfactory cases many others can be added in which *improvement* in all the symptoms is recorded, and also another long list in which the jacket has been a valuable adjuvant after laminectomy. Still again, the usefulness of the jacket is demonstrated in a large list of injuries, among which may be mentioned sprains, concussion, hæmorrhage, lacerations, and inflammatory thickenings.

Thus it is evident that *immediate extension* and *counter-extension* with immobilization by means of the jacket in all forms of spinal injuries offers the most satisfactory plan of treatment that has as yet been suggested, a plan of treatment, too, in which the results are such as to leave little to be desired, and a plan of treatment further that has been attended with a most unprecedented success.

Before dismissing the subject of the treatment of spinal injuries, too much stress cannot be laid upon the great importance of preventing cystitis, which in turn establishes a pyelitis, and eventually leads to death. The operation of perineal cys

FIG. 1.—POSTERIOR VIEW.

FIG. 2.—ANTERIOR VIEW.

Patient with fracture of spine in the cervical region, showing application of jacket.

totomy has been performed a number of times in fractures of the spine by Mr. Darrier Harrison, who inserted a rubber lithotomy-tube into the bladder through the perineum and attached to the tube a piece of India-rubber tubing, which carried the urine from the bladder to a vessel upon the floor. By this means the urine was not permitted to collect in the bladder, and the parts about the genitals were kept free from excoriation. The bladder was washed out twice daily by antiseptic solutions. Two sets of tubes were employed for each case, so that when one set was in use for twenty-four hours the other set was washed in hydrochloric acid, and kept standing in a solution of bichloride of mercury. In this way the bladder was kept free from cystitis, the perineum and buttocks dry, and bedsores avoided. If the perineal cystotomy is not performed, the rubber catheter should be boiled each time before introduction and immersed in an antiseptic solution at the time.

The conclusions to which the writer has arrived, after carefully studying the histories of many reported cases and from his own clinical experience with a very large number of cases of traumatisms of the spine, are as follows:

Traumatisms of the spine, either with or without compression of the cord, should be immediately subjected to extension and counter-extension, and then immovably fixed by the plaster-of-Paris jacket.

The situation of the fracture in the cervical region, but below the fourth cervical, seems to have no special influence in regard to the benefits to be derived from the use of the jacket, since recovery has followed fractures of the lower cervical vertebræ as well as in those cases in which the fracture was situated in the dorsal and the lower lumbar regions.

The most unpromising case is not to be deprived of the benefits of the jacket, since cases have recovered which have been considered beyond the reach of surgical aid.

The usefulness of the jacket is greatly enhanced by the administration of the iodide of potash in moderate doses at first, and subsequently increased to very large doses three times daily. The drug must be pushed to the extreme and continued without interruption for several weeks.

Cases of injury of the spine in which well-marked symptoms are present and have existed for some time have been greatly improved and in some cases cured by the jacket, so that its use with a hope of success is not alone confined to those injuries which are very recent.

The plaster-of-Paris jacket is a most useful adjuvant for immobilization of the spine after the operation of laminectomy, and under these conditions great benefit is to be derived from this method of after-treatment.